(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 331 295 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89301091.8

(22) Date of filing: 03.02.89

(51) Int. Cl.⁴: E21B 43/36

The title of the invention has been amended (Guidelines for Examination in the EPO, A-III, 7.3).

(30) Priority: 03.02.88 NO 880465

(43) Date of publication of application: 06.09.89 Bulletin 89/36

(84) Designated Contracting States: DE ES FR GB IT NL

(71) Applicant: NORSK HYDRO A.S.
Bygdoy Allé 2
N-0257 Oslo 2(NO)

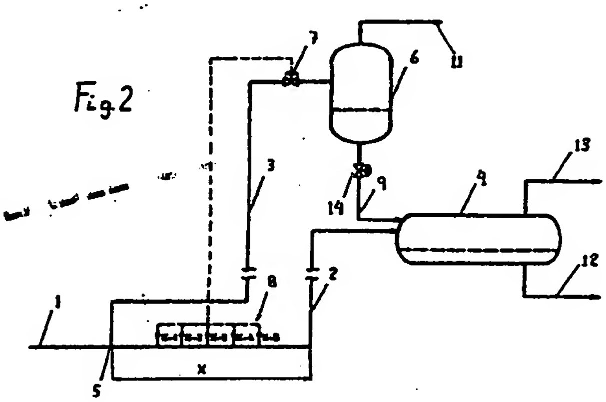
(72) Inventor: Kaasa, Oyvind
Heisholt
3745 Ulefoss(NO)

(74) Representative: Allen, Oliver John Richard et al
Lloyd Wise, Tregear & Co. Norman House
105-109 Strand
London, WC2R 0AE(GB)

(54) Pipeline system to separate a two-phase fluid flow.

(57) An integrated system for separation of gas, from a two-phase flow of oil and gas, in a secondary riser. The oil and gas is transported in a pipeline (1), e.g. from an oil well, at the seabed and by risers (2, 3) onto the platform. The main riser (2) for transporting oil is connected to an oil storing tank (4) situated on the platform. The secondary riser is connected via a T-junction (5) to the pipeline (1) at a distance (X) from the main riser and leads to a gas-scrubber (6) on the platform. The secondary riser contains a regulating valve which is operated by controlled means in such a way as to keep the interface between the gas and the oil at a relatively constant location in the pipeline between the T-junction and the main riser. The section of the pipeline (1) between the T-junction (5) and the main riser (2) incorporates sensors for detecting the proximity of the interface.

Fig.2



EP 0 331 295 A1

INTERGRATED SYSTEM FOR TRANSFORMING LIQUID FLOW PATTERNS

The present invention relates to a system for the separation underwater of the phases of a two-phase fluid flow into respective risers, e.g. as with an offshore platform, where oil and gas are transported by a pipeline along the seabed and by risers to the platform.

When developing an oil and gas offshore field it is desirable to transport the oil/condensate and gas in a two-phase flow-line. The pipeline will be connected to a main riser leading the oil and gas to the platform. However, slugging is a relatively common problem associated with two-phase flow of oil and gas in pipelines and in risers. It constitutes the formation of a plug of oil, which has separated from the two-phase flow. The probability of slugging is relatively large. Hence the process apparatus have to be designed to handle the phenomenon.

A two-phase flow in a horizontal pipeline system gives various flow patterns depending on the pipe diameter, geometry temperature and type of oil. Generally said, the flow pattern can be divided into the following categories: stratified, bubble, slug and annular flow.

A two-phase flow in a vertical pipe can also be divided into various flow patterns. Technically speaking the slug flow will give the greatest problems as mentioned above. There are two types of slugging, the normal slugging and extreme slugging. The extreme slugging depends on the geometry and occurs only in the riser when the oil and gas velocity is so low that the horizontal flow is stratified. Normal slugging is hydrodynamic and can be formed both in the horizontal and the vertical pipe section.

To avoid slugs having to be carried directly to a slug catcher system in process apparatus on an offshore platform, a separator for separation of the liquid- and gaseous phase has previously been developed. In such a known pipe separator the gas and oil are separated by feeding the flow from one common pipe into two or more parallel pipes. Such separators require large space and are expensive to build.

Separators based on a large volume tank, where the tank capacity is dimensioned to handle the peak value of the liquid flow, are also known. Such separators require less space than the abovementioned separator, but they require a complicated regulation system of the liquid level.

One other type of separator is known from Norwegian patent application No. 853656. This is a separator for dealing with the accumulation of slugs during transmission of offshore natural oil and gas. It is partly based on a separator located on the platform, partly on a separator located at the seabed. The apparatus comprises a secondary riser teed off the main transportation pipeline at a point where the pipeline starts to make a large loop, and the secondary riser leads to a separator tank on the platform after passing a choke valve. When a slug passes the teed off secondary riser, some of the liquid will pass into the secondary riser. At the time when the slug has passed the tee, the liquid in the secondary riser will partly flow back into the main pipeline and partly, due to the line pressure, will ascend the secondary riser and pass through the choke valve and into the separator on the platform.

One disadvantage with the last-mentioned separator is that it is only useful for so-called normal slugs, e.g. slugs located in the main pipeline, and not extreme slugs in the riser. If this device had been designed to deal with extreme slugs in the riser, the separator on the platform would have had to have been designed according to the previously mentioned methods for separation of a two-phase flow, and in those circumstances the secondary riser would be redundant.

A common feature of the aforementioned three types of slug catchers is that all three make use of some type of phase separator on the platform. Since the total capacity of the slug catchers has to be larger than the largest expected slugs it will occupy expensive and limited space on the platform.

In accordance with the invention a system for the separation underwater into phases of a fluid flow having at least two phases comprises an underwater pipeline, a main riser connected to the pipeline and a secondary riser connected to the pipeline upstream of the main riser via a T-junction wherein the secondary riser ascends to a separation plant and includes flow restriction means, characterised in that the T-junction is positioned along the pipeline a prescribed distance from the main riser, the flow restriction means is a controlled regulating valve, and there is controlling means responsive to the position of the liquid/gas interface along the pipeline for controlling the setting of the regulating valve so as to maintain the position of the said interface constant. This allows for a total separation of the phases of a two-phase flow on the seabed and outside the platform, e.g. in a pipe system connecting the oil/gas pipeline on the seabed with the processing plant onshore.

The system is especially designed to deal with extreme slugs which occur normally at low liquid and gas velocity, i.e. at startup and shut-down of the production. The main advantage of the system, which is designed to be located on the seabed, is

that it has no moving parts, is simple and easy to manufacture, and is reliable and simple to maintain.

The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic drawing of an offshore oil platform including a system generally in accordance with the invention; and

Fig. 2 is a simplified process illustrating the system.

Figure 1 illustrates an offshore platform 10 for transportation and processing of oil and gas from a remote subsea installation or well via a riser 2 to the processing plant on the platform 10. The pipeline 1 is connected to a separate secondary riser 3 via a T-junction 5 located at a distance X from the riser 2.

As shown in Fig. 2, the secondary riser is connected to a gas scrubber 6 located on the platform. A storage tank 4 is provided with a drainpipe 12 for the oil and one discharge pipe 13 for any gas that has evaporated from or was mixed with the oil.

A detection means 8 is provided to determine the location along the pipe 1 of any oil/gas interface. As shown, this detector comprises five capacitive detectors K_1-K_5 arranged in the pipeline section between the T-junction 5 and the riser 2. The capacitive detectors K_1-K_5 detect the presence of an oil/gas interface in the pipeline. The capacitive detectors are connected to a level indicator and give electrical signals to a control unit (not shown) which controls a regulating valve 7 located on the secondary riser 3.

The oil and gas transported in the main pipeline 1 are separated at the T-junction 5, where the gas components of the two-phase flow pass into the secondary riser 3 and the oil components pass into the pipeline 1 downstream of the T-junction and into the riser 2. The pipeline 1 between the T-junction and the riser 2 should be slightly sloped so that a liquid seal is formed in the riser. The regulating valve 7, by venting the gas, regulates the pressure in the pipeline 1 and in the riser 2.. The regulation is done according to the signals from the capacitive detectors K_1-K_5 in the pipeline. Thus the regulating valve 7 will open at increasing gas pressure in the secondary riser when the liquid/gas interface reaches the detector K_1. The riser 2 will therefore contain fluid which is 100% oil and the oil/gas interface at all times will be located between the T-junction and the riser 2.

The accuracy of the oil/gas interface detection is of course dependent on the number of detectors situated in the pipeline and the distance between them. The detection means may comprise more or less than five capacitive detectors or equivalent detectors of another type capable of detecting the presence of the liquid/gas interface. Such detectors might comprise pressure sensors located in the scrubber, the storing tank and the pipeline. By means of the difference and the variation of pressure the position of the liquid/gas interface in the pipeline can be determined.

To optimize the separation of the oil and gas the pipes may have different diameters and lengths. To determine the optimum length of the pipes it is important to make sure that the system can deal with the peak values of slugs. Tests have shown that a distance X between the T-junction 5 and the riser 2 should be at least two times the height of the riser.

Although as noted above the pipes can be of different diameters, it is regarded as being an advantage to be able to clean the inside of the pipes by using a "pig". The pipeline 1 and the risers 2, 3 should therefore have the same diameter and be as free as possible of obstacles such as valves, bends, etc.

The angle of inclination of the pipeline between the tee section and the riser is also important. Tests have indicated that it should be approximately 2° to the horizontal. To achieve the best separation of the two-phase flow the angle between the upright of the T-junction 5 and the main pipeline 1 may be an angle other than 90°, as illustrated in the drawings.

Claims

1. A system for the separation underwater into phases of a fluid flow having at least two phases, such as oil and gas from a seabed oil well, said system comprising an underwater pipeline, a main riser connected to the pipeline and a secondary riser connected to the pipeline upstream of the main riser via a T-junction wherein the secondary riser ascends to a separation plant and includes flow restriction means, characterised in that the T-junction 5 is positioned along the pipeline 1 a prescribed distance from the main riser 2, the flow restriction means 7 is a controlled regulating valve, and there is controlling means 8 responsive to the position of the liquid gas interface along the pipeline for controlling the setting of the regulating valve so as to maintain the position of the said interface constant.

2. A system according to Claim 1 wherein the controlling means includes sensing means K_1 to K_5 located at least along the pipeline between the main riser 2 and the T-junction 5 connecting the secondary riser 3 to the pipeline.

3. A system according to Claim 2 wherein the sensing means comprises a sequence of capacitive detectors K_1-K_5 in the pipeline, each responsive to the proximity of the gas/liquid interface.

4. A system according to Claim 2 wherein the sensing means comprise pressure sensors and the latter are arranged also in the scrubbing means 6 and in tank storage means 4, both of which means are within the separation plant.

5. A system according to any preceding claim wherein the distance between the T-junction 5 which connects the secondary riser 3 to the pipeline 1 and the main riser 2 is at least twice the height of the main riser.

6. A system according to any preceding claim wherein the portion of the main pipeline situated between the two risers is inclined upward away from the T-junction.

7. A system according to Claim 6 wherein the angle of inclination is 2°.

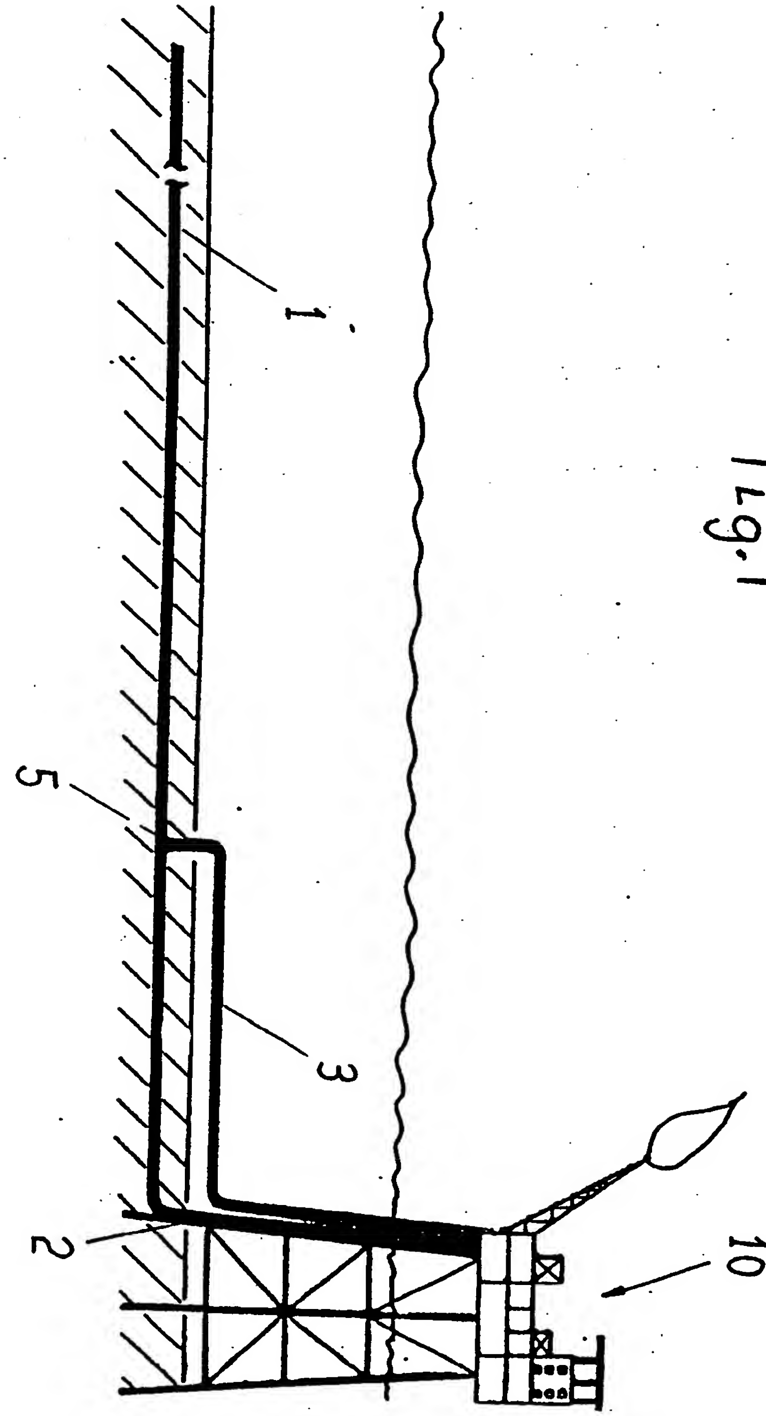


Fig. 1

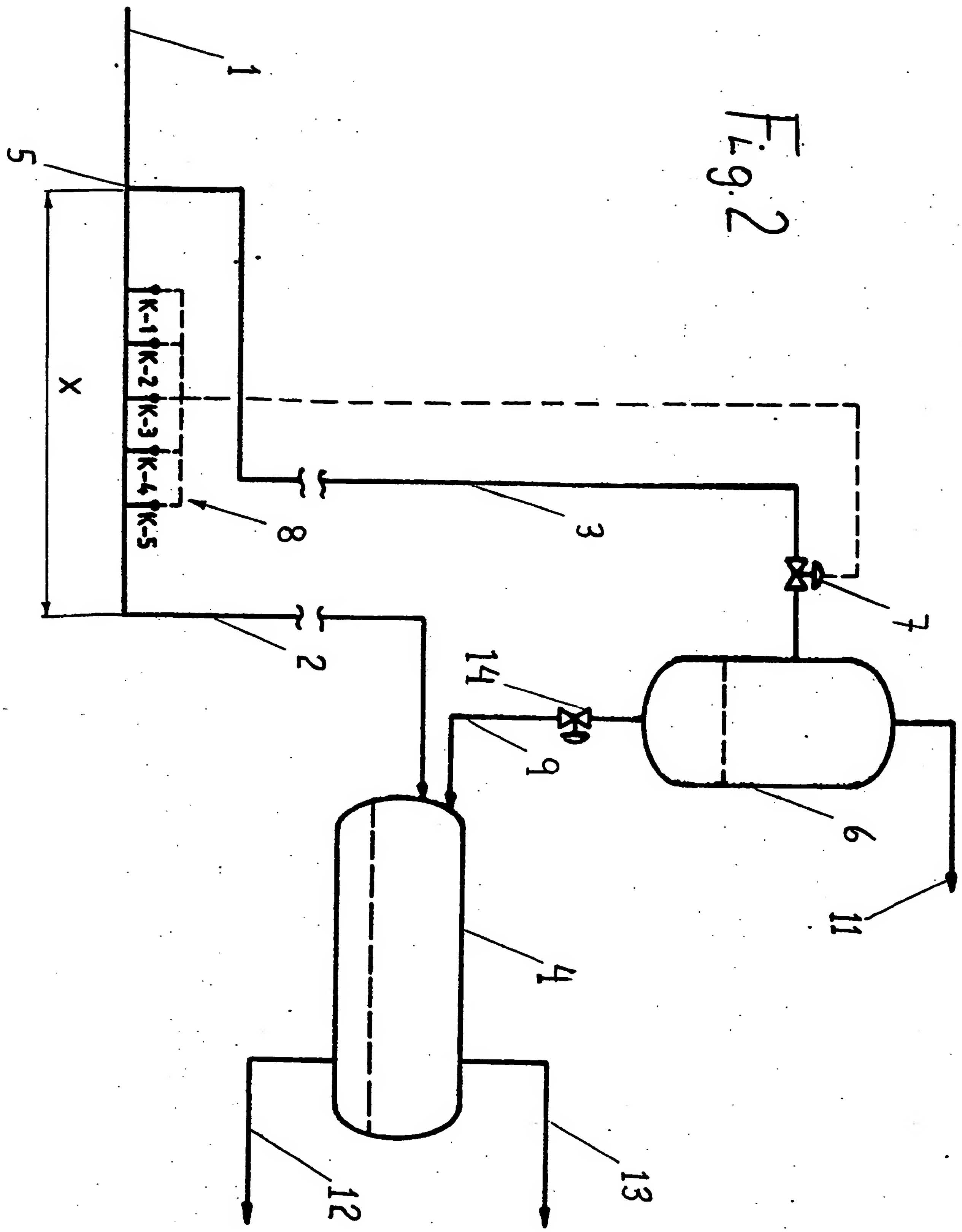


Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 1091

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,A	WO-A-8 701 759 (SINTEF) * Abstract; claim 1 * ---	1-7	E 21 B 43/36
A	US-A-4 708 793 (CATHRINER et al.) * Abstract * ---	1-7	
A	FR-A-2 401 379 (TEXAS EASTERN ENGINEERING LTD) * Claim 1 * ---	1-7	
A	OIL & GAS JOURNAL, vol. 77, no. 46, November 1979, pages 230-238, Pennwell Publishing Co., Tulsa, Oklahoma, US; Z. SCHMIDT et al.: "Choking can eliminate severe pipeline slugging" * Whole document * -----	1-7	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 21 B
F 17 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17-04-1989	HEDEMANN,G.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document